AMINONAPHTHALIMIDE-SQUARAINE DYAD: PHOTOPHYSICAL PROPERTIES AND BIOIMAGING APPLICATION

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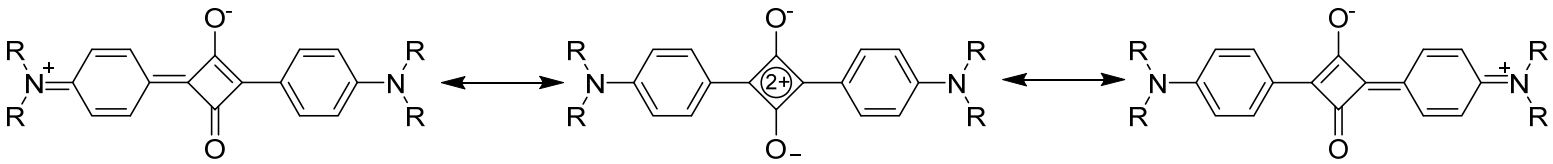
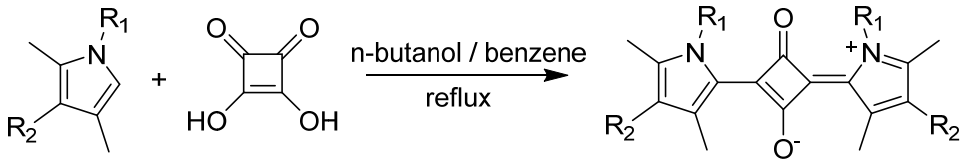
6 JIF Jornadas Ibéricas de Fotoquímica
12- 14 DE SETEMBRO, 2018 Aveiro

Squaraine fluorophore

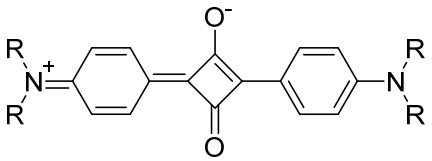


Donor **Acceptor** **Donor**

Treibs and Jacob (1965)

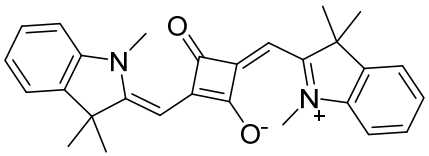


Sprenger and Ziegenbein (1966)



Aromatic squaraine

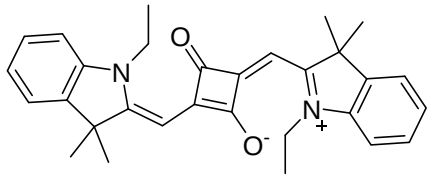
Sprenger and Ziegenbein (1967)



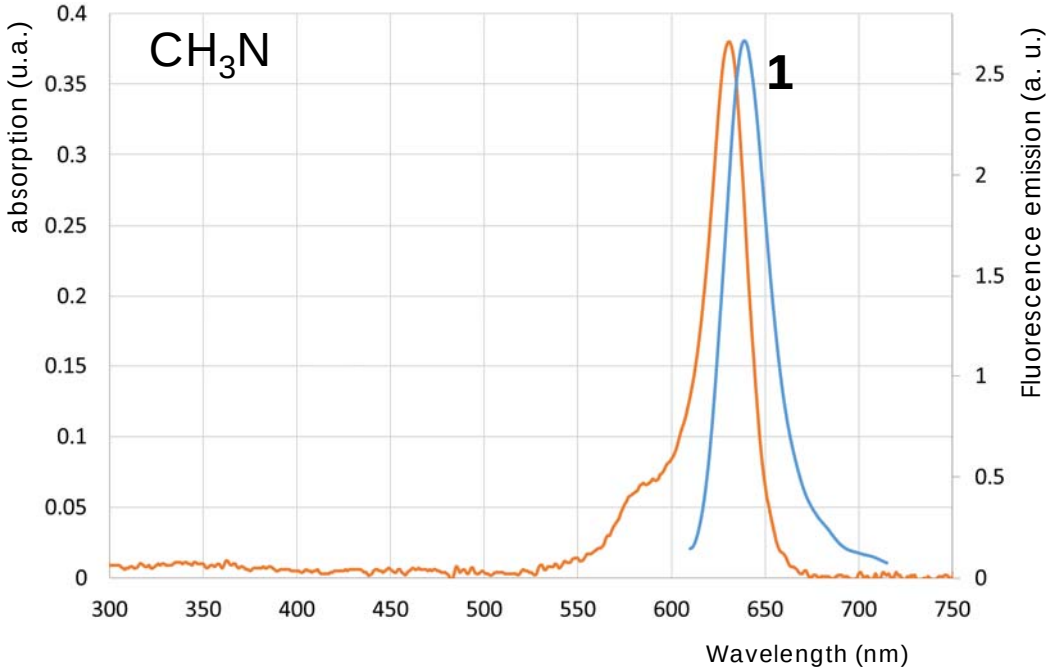
Heterocyclic squaraine

Squaraine fluorophore

1

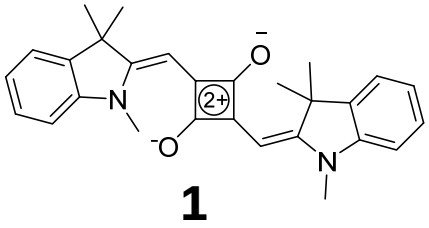


Heterocyclic squaraine



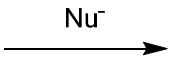
Solvent	λ_{abs} max (nm)	ε (x 10^5 M^{-1} cm^{-1})	λ_{em} max (nm)	Φ_{FL}
CH_3CN	638	2.40	642	0.12
Toluene	641	3.28	651	0.38

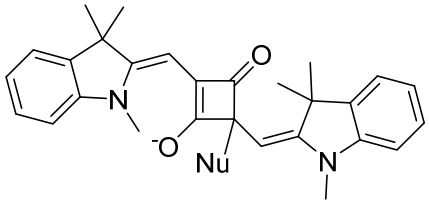
Squaraine fluorophore: interaction with nucleophiles



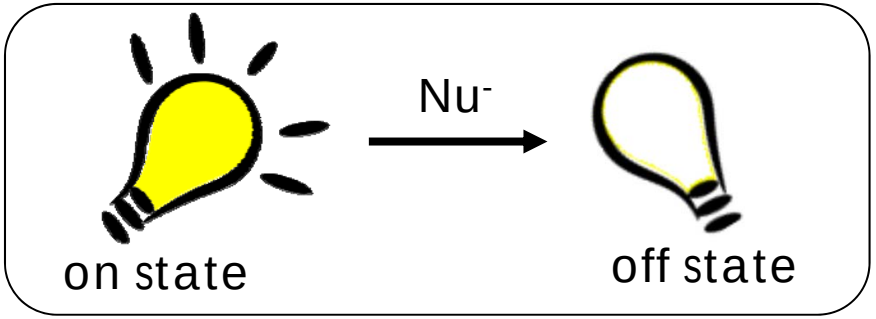
1

Heterocyclic squaraine



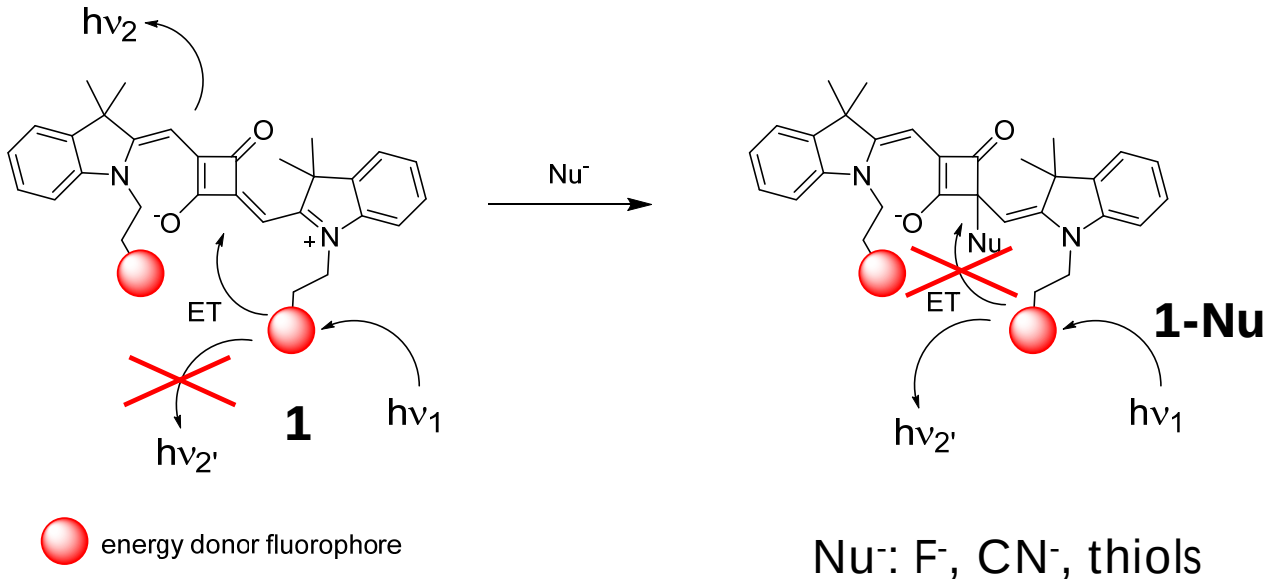


Nu^-: F^-, CN^-, thiols

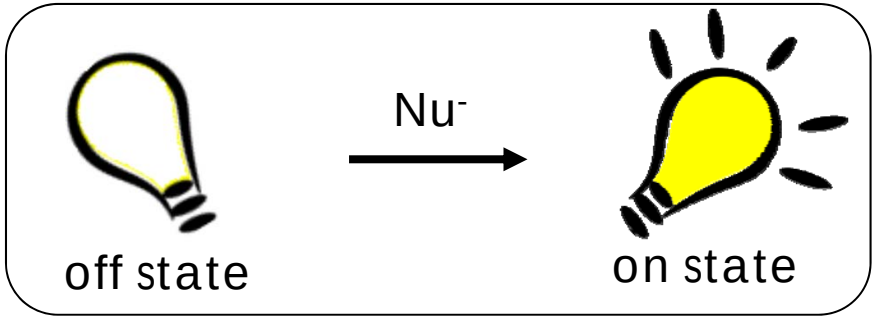


"Turn-off"

Squaraine fluorophore: interaction with nucleophiles

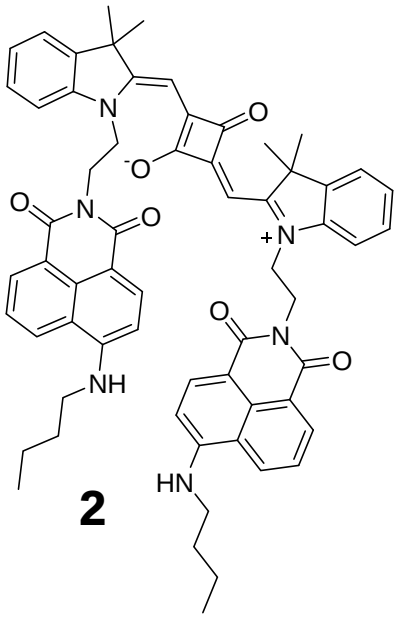


Nu⁻: F⁻, CN⁻, thiols



"Turn-on"

4-Amino-1,8-naphthalimide-squaraine-dyad



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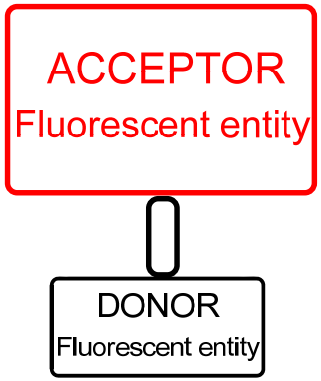
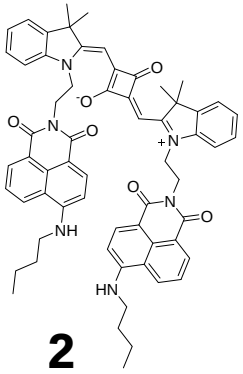


Energy Transfer Cassettes

naphthalimide-squaraine-dyad



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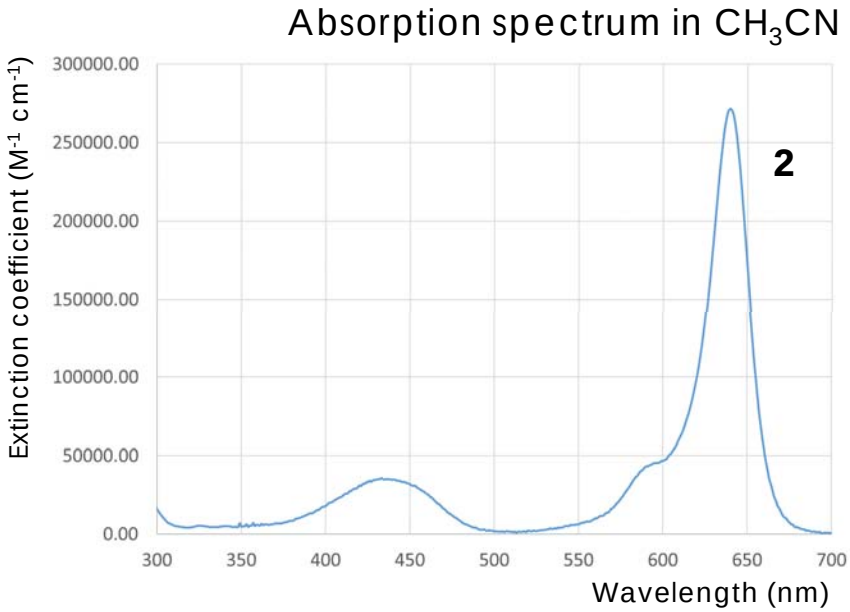

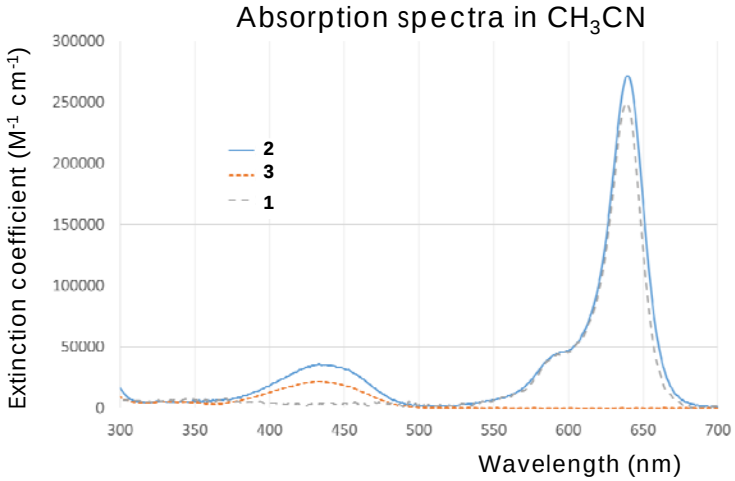

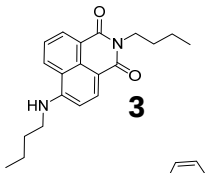

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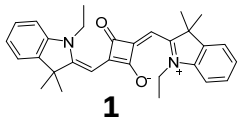
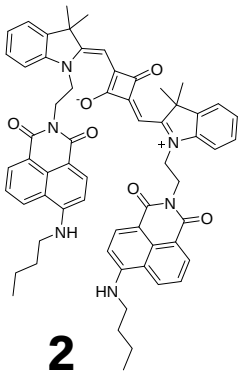


1

naphthalimide-squaraine-dyad



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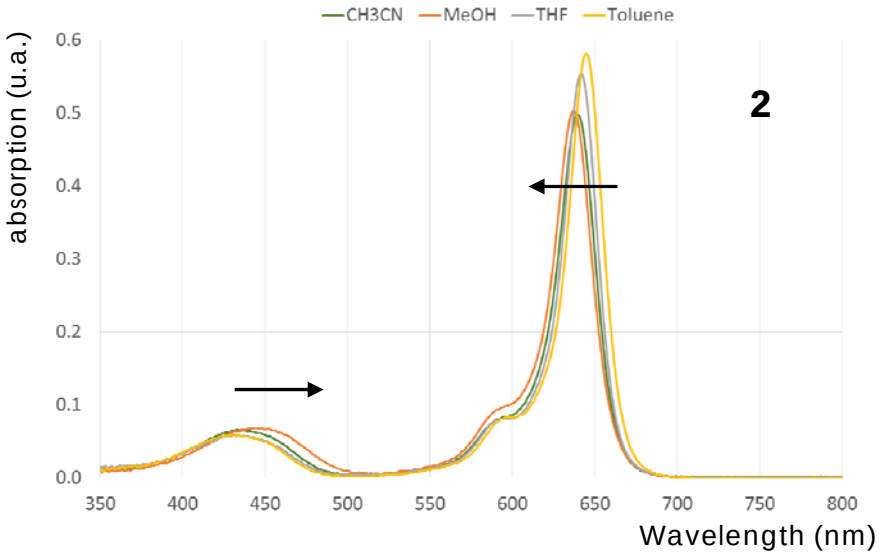
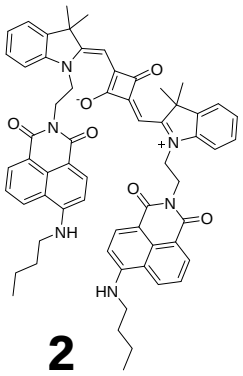


Absorption spectra of 2 (1,8 μM) in different solvents

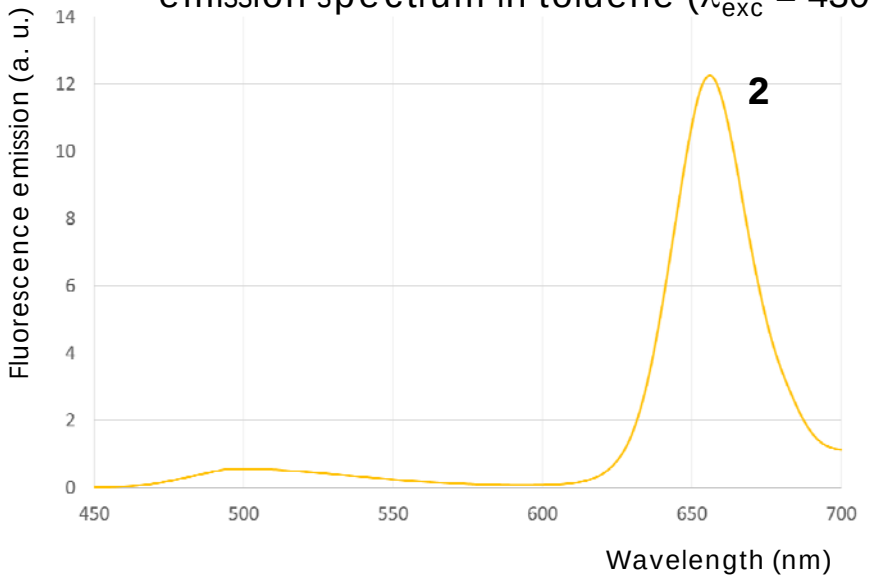
Solvent	$\lambda_{naftalimide}$ (nm)	$\lambda_{squaraine}$ (nm)	ε ($M^{-1}cm^{-1}$)
MeOH	446	637	2.64
CH_3CN	437	639	2.71
THF	433	642	3.03
Toluene	433	646	3.18

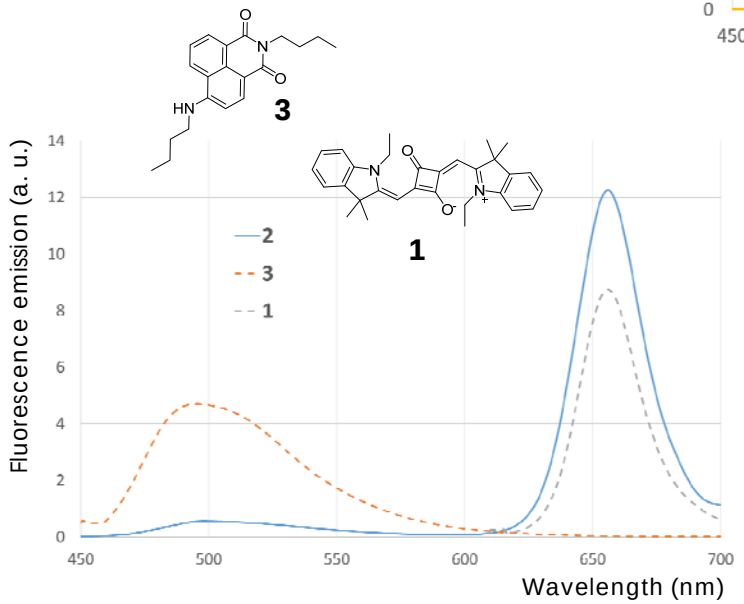
naphthalimide-squaraine-dyad



2

emission spectrum in toluene (λ_{exc} = 430 nm)





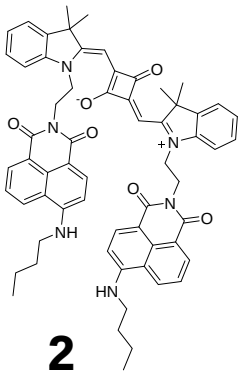
Calculation data of energy transfer in toluene

R_0 = 20.1 Å

J = 1.96 x 10^{-11} cm^6mol^{-1}

Φ_{EET} = 0.985

naphthalimide-squaraine-dyad



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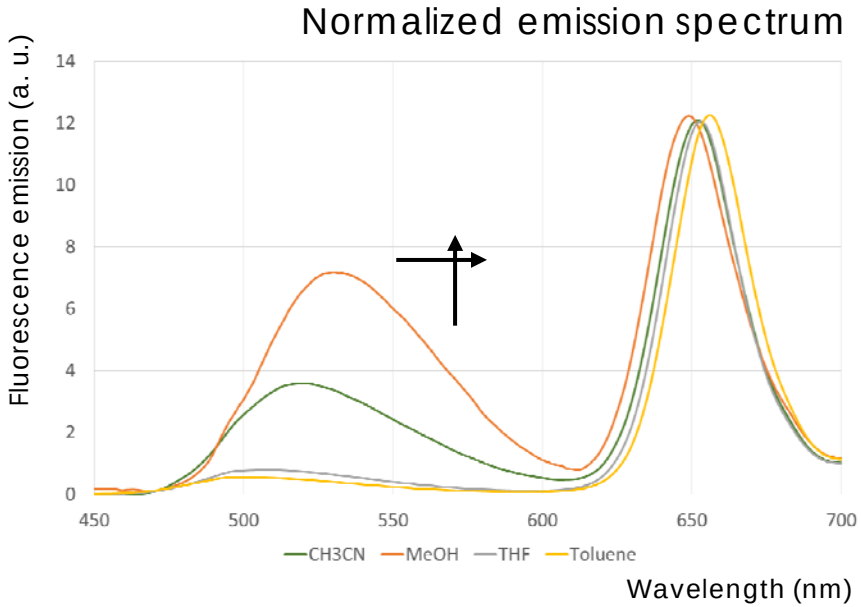
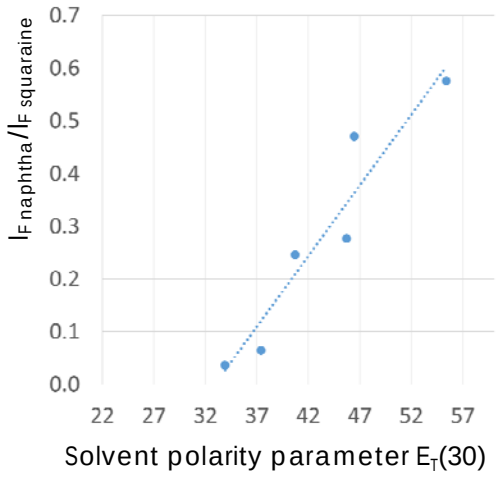
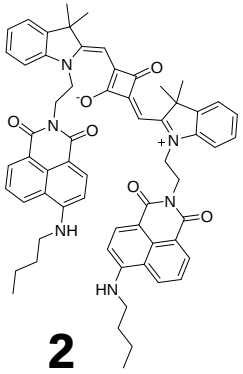




Emission spectra of 2 (1,8 μM) in different solvents

Solvent	$\lambda_{naftalimide}$	$\lambda_{squaraine}$	Φ	$I_{F\ naphtha}/I_{F\ squaraine}$
MeOH	532	650	0.06	0.58
CH_3CN	521	652	0.15	0.28
THF	506	653	0.27	0.07
Toluene	503	656	0.31	0.04

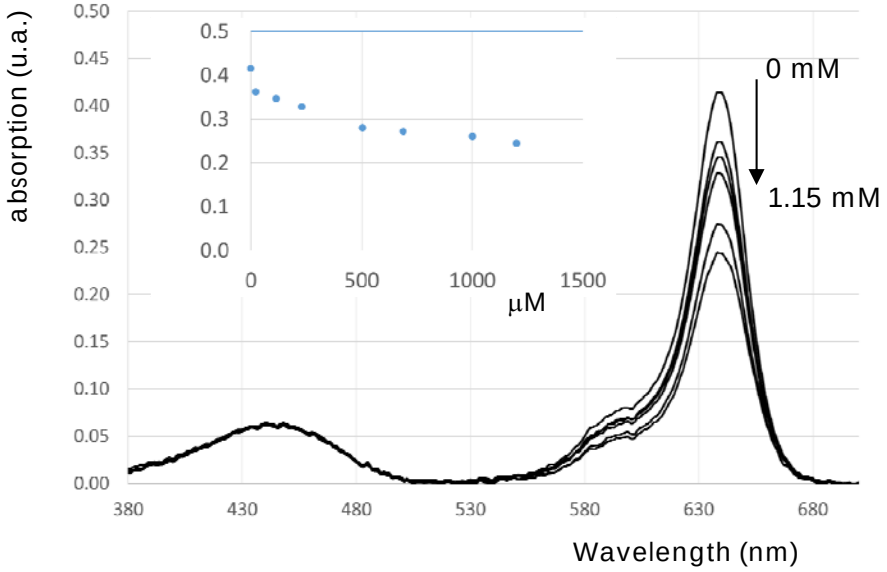
naphthalimide-squaraine-dyad



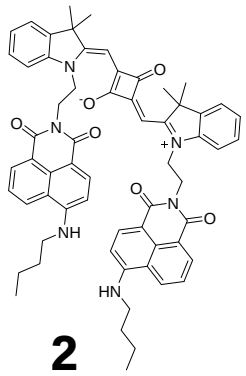
2

Effect of nucleophiles: NaCN

Absorption spectrum of **2** (2,0 μM) in $CH_3CN:H_2O$ (9:1)



naphthalimide-squaraine-dyad

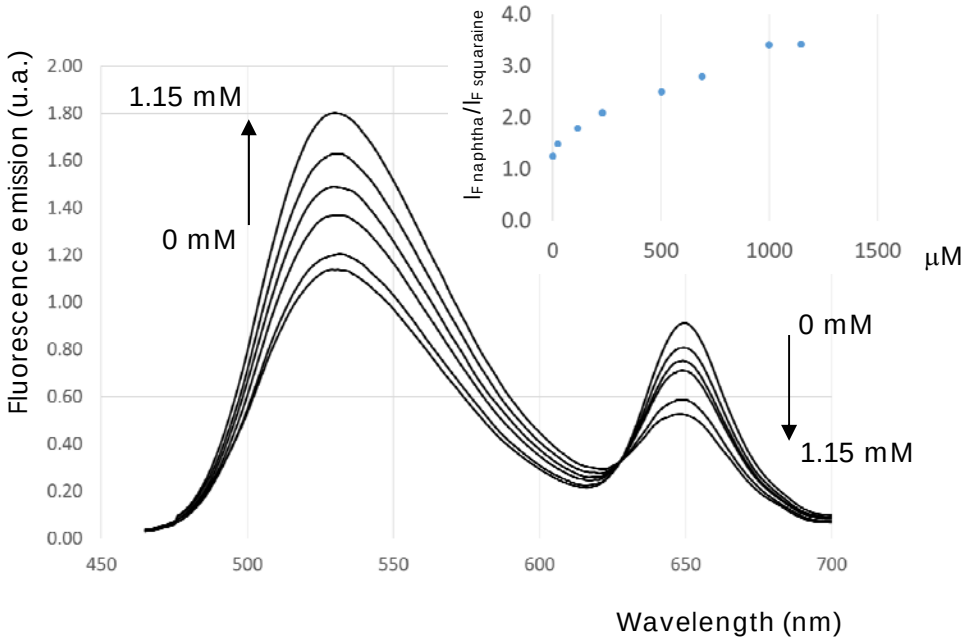


2

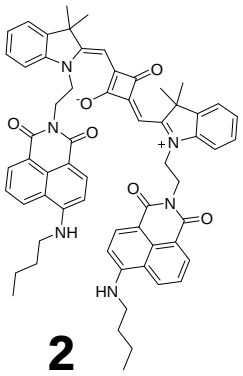
(λ_{exc} = 440 nm)

Effect of nucleophiles: NaCN

Emission spectrum of **2** (2,0 μM) in $CH_3CN:H_2O$ (9:1)

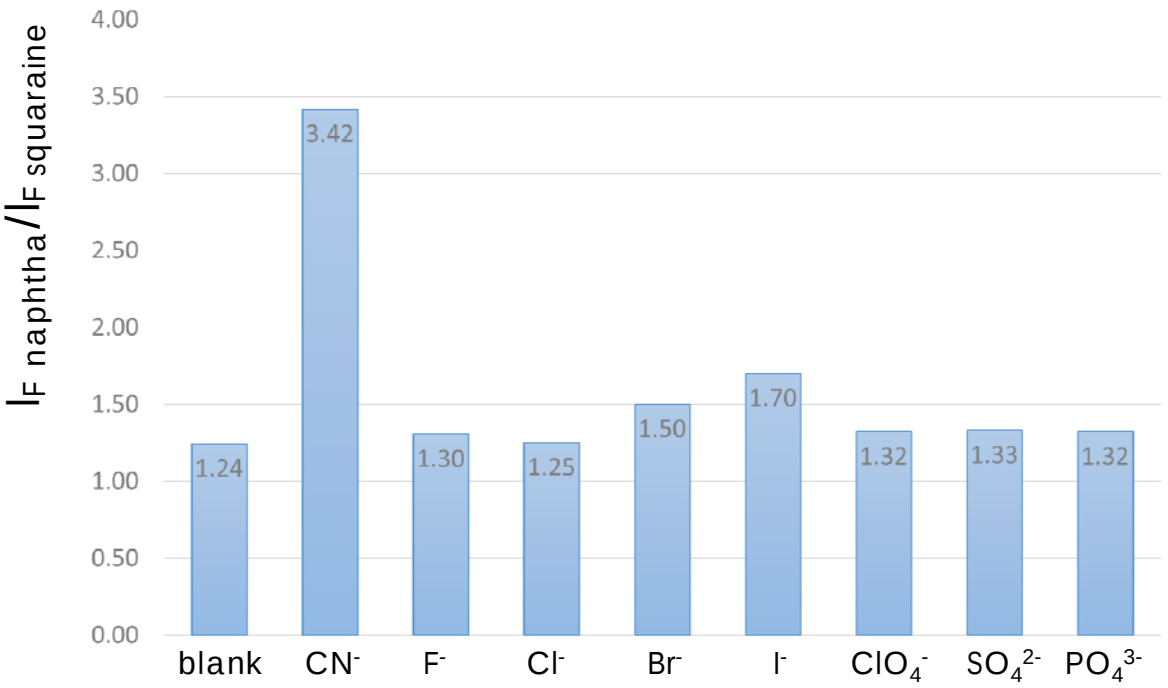


naphthalimide-squaraine-dyad



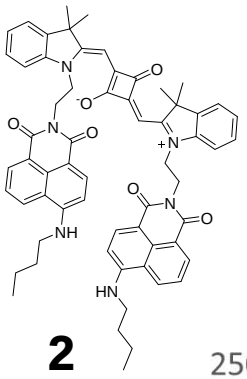
2

Effect of nucleophiles



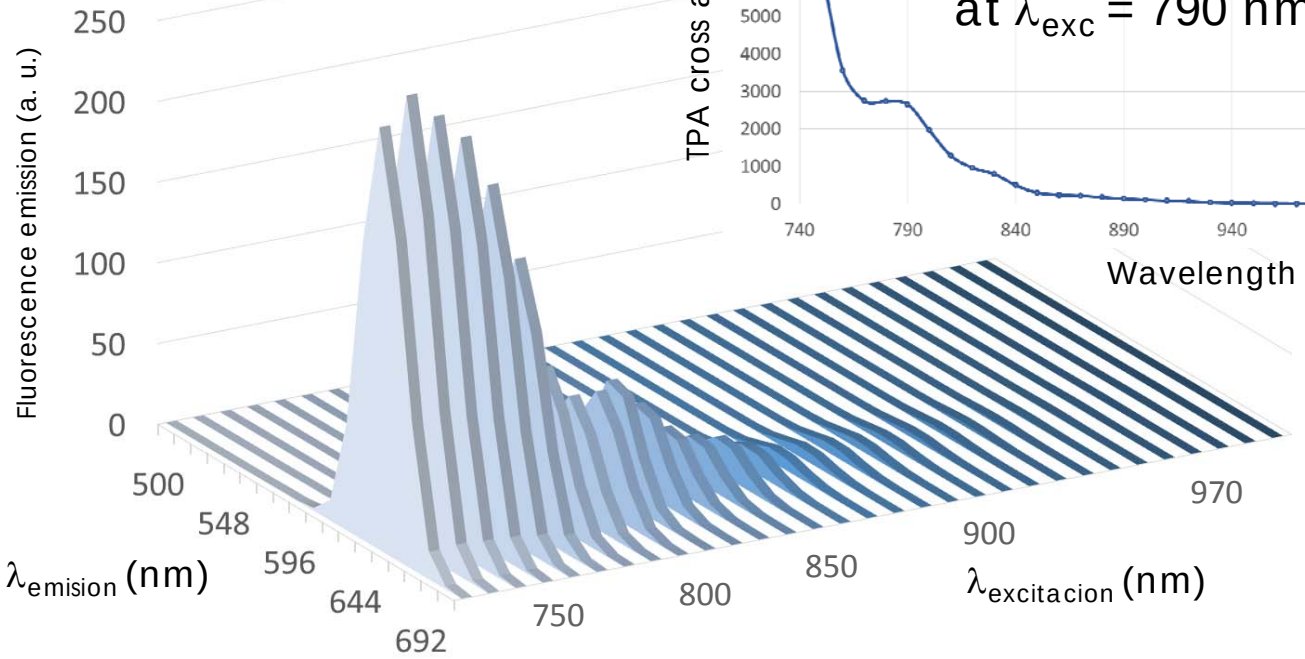
Maximum emission spectra change in presence of some anions in $CH_3CN:H_2O$ (9:1)

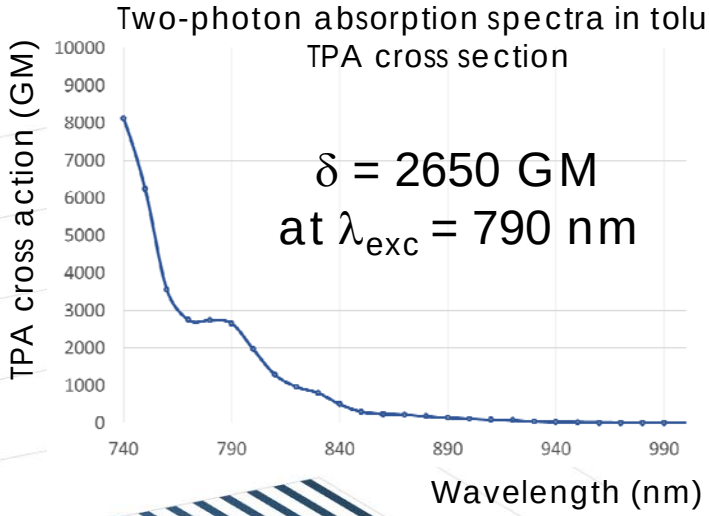
naphthalimide-squaraine-dyad



2

Two photon emission





δ = 2650 GM
at λ_{exc} = 790 nm

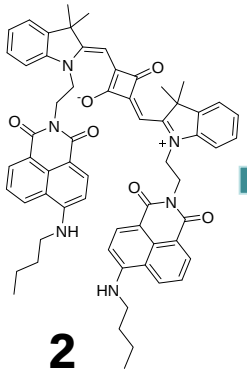
Two photon emission spectra of 2 (2.6 μM) in toluene

One photon fluorescence microscopy imaging

excitation channels

633nm

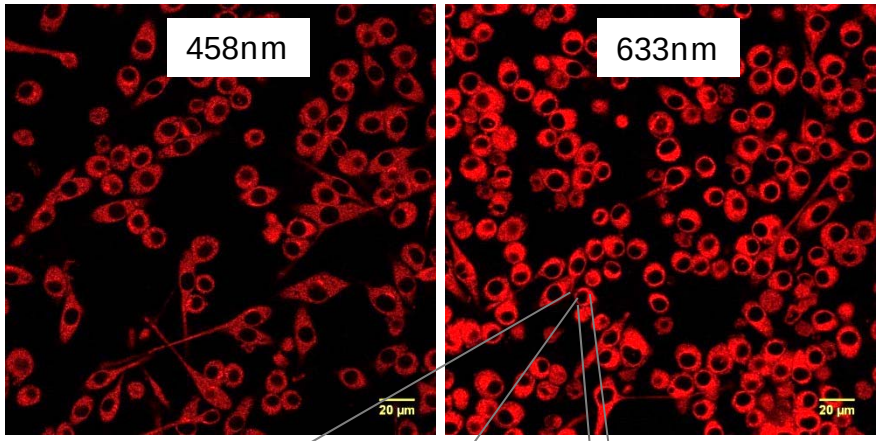
453nm

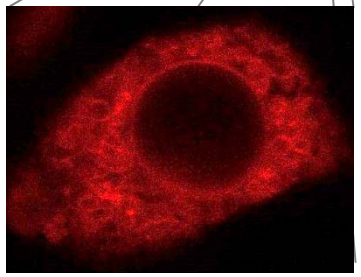


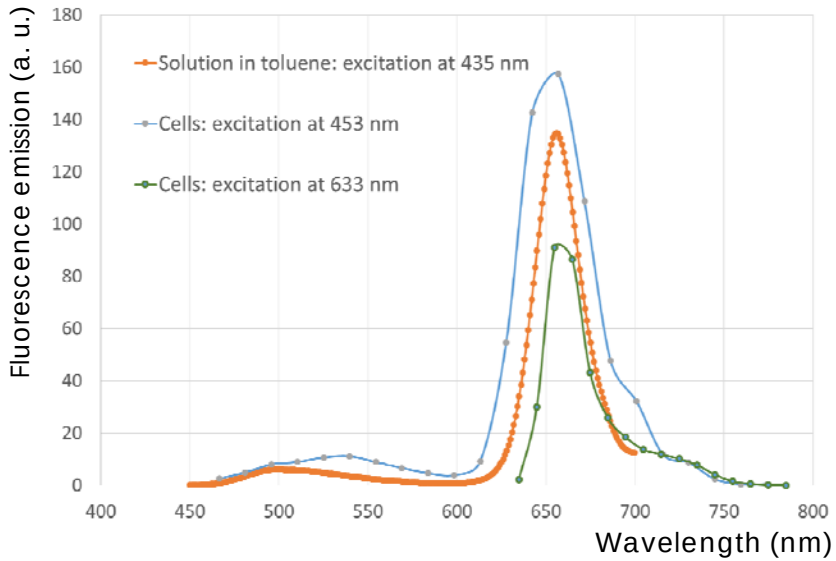
650nm

2

Confocal microscopy images of N13 microglial cell line incubated with **2** (10^{-7} M)



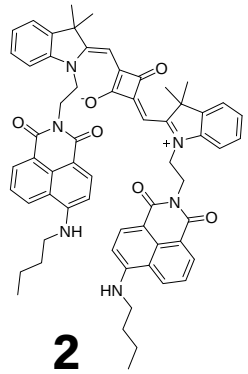




Confocal fluorescence emission

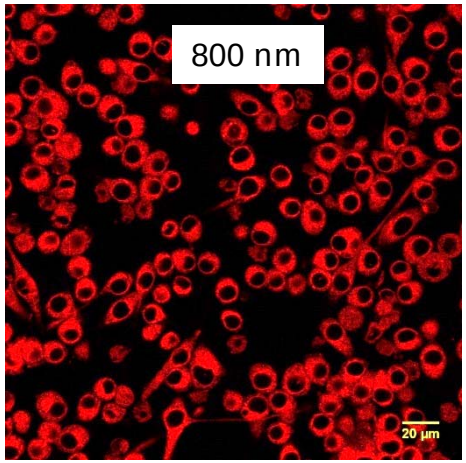
Cells: $I_{F\ nafta}$ / $I_{F\ squaraine}$ = 0.07

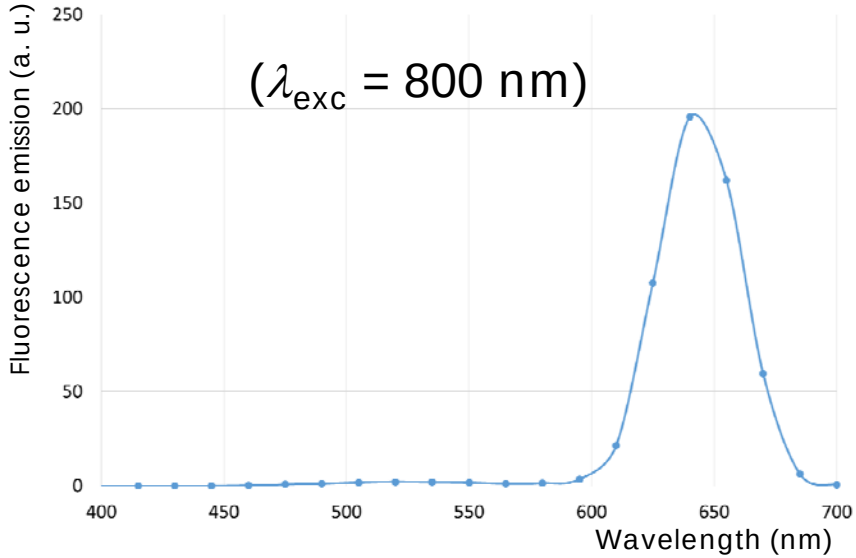
Two-photon fluorescence microscopy imaging



2

Two photon microscopy images of N13 microglial cell line incubated with **2** (10^{-7} M)





Two photon fluorescence:

$I_{F\ nafta}$ / $I_{F\ squaraine}$ = 0.01

Confocal fluorescence:

$I_{F\ nafta}$ / $I_{F\ squaraine}$ = 0.07

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Thanks you for your attention

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Ministerio de Economía y Competitividad (Spain)

Consejería de Salud, Junta de Andalucía (Spain)